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AUTHOR St. Cyr, David; And Others
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ABSTRACT

This curriculum contains materials for use in duplicating the 11-week course for machine operators that was implemented at New Hampshire Vocational-Technical College in Nashua, New Hampshire. Addressed in the course, which is designed to prepare entry-level employees, are the following topics: basic math, blueprint reading, layout tools and procedures, hand tools and benchwork, measurement and inspection tools, fundamentals of machining, and operation of machine tools. The curriculum package includes: a discussion of the scope of the program; the name and address of a curriculum contact person; job descriptions outlining the principal duties of machine operators and machinists; program attendance, schedule, and grading policies; a unit outline; a duty listing; a duty-by-duty listing of tasks for machine operators; a list of performance objectives that is cross-referenced to a list of duty and task statements; knowledge and attitude profiles; a list of laboratory safety procedures; and a 7-item bibliography. (MN)

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MACHINE OPERATOR TRAINING PROGRAM AND CURRICULUM

BY

DAVID ST. CYR, WILLIAM A. MCINTYRE, RONALD G. BLANKENSTEIN

N.H. VOCATIONAL-TECHNICAL COLLEGE
505 AMHERST STREET
NASHUA, N.H. 03060

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The Machine Operator Training Program was a successful training program offered by the New Hampshire Vocational-Technical at Nashua and a consortium of local companies. The program was a viable three-way partnership between the college which provided the instruction, the local Chamber of Commerce which coordinated the program, and the companies which paid for the training of prospective employees. The program was operated ten times over a five year span and involved more than thirty small-to-large companies.

The program served to alleviate a s e manpower shortage of trained machine operators in the southern tier of New Hampshire. It was an eleven-week program that ran Monday through Friday from 4:00 o'clock p.m. to 10:00 o'clock p.m.

Applicants were carefully screened for the training program. After advertising in local media that a training program was to begin soon, an information night was held at the college for discussion and administration of a vocational test battery. Physical examinations were also given. Representation from companies interviewed prospective candidates. Based on this information, those persons with the most chance of success were invited to participate.

The curriculum itself went through an evolutionary process that involved a unique partnership between the companies and the college. It was continually reviewed and revised until the third cycle of graduates finally met the skill levels desired by the companies involved. The importance of the three-way partnership and the ongoing

curriculum review and revision cannot be overstated. It was a very successful partnership between industry and education and consistent with the need to further the economic development of the state. The industry has recently been comfortable in its labor force of trained machine operators; however, the industry is very cyclic and may require new training programs.

The curriculum which follows reflects the most current revision to the machine operator training program. The format follows closely the recommendations in Developing Vocational Instruction by Robert F. Mager and Kenneth M. Beach, Jr.

SCOPE OF PROGRAM

The eleven (11) week Machine Operator Training Program is designed to provide the entry level employee with the minimum skills and knowledge necessary to become competent machine operators. The program will deliver employees who:

1. Can work with decimals and fractions.
2. Can read and work from blueprints.
3. Can use precision measuring instruments.
4. Understand the fundamentals of machining and the operation of machine tools.
5. Are familiar with basic hand tools and benchwork.
6. Are pre-screened.
7. Are geared to industrial expectations.
8. Have demonstrated motivation.

It is a training program in machining for persons with little or no shop background which provides them with the necessary math skills and basic knowledge to become competent machine operators.

Sponsoring industries provide the program with direct program input and financial support. The entire program can be easily tailored to the needs of the sponsoring industries.

Program Content

Basic Math

Blueprint Reading

Layout Tools and Procedures

Hand Tools and Benchwork

Measurement and Inspection Tools

Fundamentals of Machining

Operation of Machine Tools

FOR FURTHER INFORMATION ON THE TRAINING PROGRAMS AT

THE NEW HAMPSHIRE VOCATIONAL TECHNICAL COLLEGE, NASHUA

PLEASE CONTACT:

Ronald G. Blankenstein, Dean
Extension Division
New Hampshire Vocational Technical College
505 Amherst Street
Nashua, New Hampshire 03063

Phone: (603) 882-7022

JOB DESCRIPTION
MACHINE OPERATOR

The machine tool operator is a semi-skilled worker. The machine tool operator usually is skilled in the operation of a single machine tool, such as a drill press, lathe, or milling machine. Often the work is repetitive, making many identical parts.

The training period for machine tool operators may vary from several days to more than a year. For example, it may take only a few days to learn the operation of a small drill press. On the other hand, it may take more than a year to become highly skilled on a large radial drill press or universal milling machine. There are no specific educational requirements for the machine tool operator. However, a background of study in drafting, blueprint reading, industrial arts or vocational classes in metalwork is valuable in securing employment and advancing more rapidly. Machine tool operators frequently are paid according to their rating, which depends on training and experience.

With continued development of automatic and more versatile machine tools, production per worker will increase. Continued development of automated machine tools also may affect the number employed. However, the machine tool operators with the previously mentioned educational qualifications can easily adjust to technical changes and secure new jobs.[1]

[1] Victor E. Repp and Willard J. McCarthy, Machine Tool Technology (Ill: McKnight Publishing Co., 1979), p. 532.

JOB DESCRIPTION
MACHINIST

Machinists are skilled workers who are able to make all types of machined metal parts with machine tools. They must be able to set up and operate all of the basic machine tools and many different specialized production machine tools. They must know how to read blueprints and how to use all of the common metalworking hand tools and precision measuring instruments. There is much variety in the work, since the machinist is called to perform many different types of machining jobs on many different machines.

The machinist must know the properties and characteristics of the different metals to be machined. The heat-treating properties of many metals must also be known, since these will be used in making metal parts and cutting tools which must be heat-treated after machining. Machinists also must be able to select correct cutting speeds and feeds intelligently, and compute them, if necessary.[2]

[2] Victor E. Repp and Willard J. McCarthy, Machine Tool Technology (Ill: McKnight Publishing Co., 1979), p. 532.

TRAINING PROGRAMS
New Hampshire Vocational Technical College, Nashua, NH

ATTENDANCE/SCHEDULE/GRADING POLICIES

Students are expected to be in attendance from 4 p.m. to 10:30 pm Monday thru Friday unless the College is not in session.

SCHEDULE

4:00-5:45	Classroom instruction
5:45-6:00	Break
6:00-7:45	Shop Work
7:45-8:00	Break
8:00-9:40	Shop Work
9:40-10:00	Shop Clean up
10:00-10:30	Break

All students are expected to make arrangements with their employers to meet this schedule. Please do not ask to make exceptions.

Students are expected to meet all textbook due dates.

Students are expected to participate in all scheduled activities.

Field trips will be scheduled during the final week of the class.

During the final week interviews will be given and job offers made.

Unexcused absences will affect the quality of the job offers made.

Students are allowed three (3) unexcused absences.

Good work habits are expected, absences and tardiness are not.

Grading is PASS - FAIL.

Basic requirements to be met:

1. Complete all text assignments and score 85% or better on all tests.
2. Complete elementary and intermediate blueprint reading texts.
3. Complete all basic projects assigned within the given specifications.
4. Complete all subcontract jobs as assigned within given specifications.
5. Participate in shop clean-up including end of course clean-up.
6. Good attitude and attendance.

GOAL

To provide entry level employees with minimum skills and knowledge to become competent machine operators.

OBJECTIVES

1. Teach students safe work habits.
2. Teach students how to use standard machine tools.
3. Teach students care and respect of machine tools.

GOAL

To provide a training program with the ability to upgrade skills of workers already on the job.

OBJECTIVES

1. Program can be tailored to meet needs of individuals and companies that require a skill upgrading.

OUTLINE

I. Shop Safety

A. Personal safety
B. Safe work habits
C. Safety with hand tools
D. Fire prevention
E. First aid

II. Blueprint Reading

A. Three-view drawing
B. Use of working drawing
C. Lines, dimensions, scales
D. Dimension interpretation
E. Sectional views
F. Hole representations
G. Thread representation
H. Auxiliary views
I. Symbols
J. Specifications & tolerances

III. Shop Math

A. Addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals.
B. English system of measurement.
C. Metric system of measurement.
D. Conversion of English to metric, vice versa.
E. Intro to algebra
F. Intro to geometry
G. Intro to trigonometry

IV. Measuring Tools

A. Rules
B. Micrometers
C. Verniers
D. Layout tools
E. Dial indicators
F. Height gages
G. Combination sets

V. Screw Threads

A. Identification
B. Selection & measurement
C. Hand working

VI. Pedestal Grinder

A. Safety
B. Operation

VII. Band Saw - cut off type

A. Safety
B. Operation

VIII. Drilling & Drilling Machines

A. Safety
B. Selection & sharpening of drills
C. Speed & feeds
D. Operation of drill press
E. Operations performed on drill press

IX. Lathe

A. Safety
B. Nomenclature
C. Tool selection
D. Operation of lathe
E. Operations performed on a lathe
F. Maintenance

X. Milling Machine (Vertical & Horizontal)

A. Safety
B. Nomenclature
C. Cutter selection
D. Speed & feeds
E. Operation of milling machines
F. Operations performed on milling machines
G. Maintenance

XI. Surface Grinder

A. Safety
B. Nomenclature
C. Wheel selection
D. Operation of a surface grinder
E. Operations performed on a surface grinder
F. Maintenance

XII. Demonstrations on

A. Tool post grinder
B. EDM
C. Shaper
D. Tool & cutter grinder
E. Gear cutting
F. NC
G. Cylindrical grinder
H. Turret lathe

DUTY LISTING
MACHINE OPERATOR TRAINER

1.0 Knows the safety rules for safe operation of the shop and the machine tools.

2.0 Knows how to read blueprints.

3.0 Knows basic shop math.

4.0 Knows how to use a variety of measurement, layout, inspection, and set up tools.

5.0 Knows how to identify and use various threading systems.

6.0 Knows how to properly set up and use a pedestal grinder.

7.0 Knows how to properly use a stock cut-off saw.

8.0 Knows how to properly use a band saw.

9.0 Knows how to use drills and perform drilling operations on drill presses and related machines.

10.0 Be proficient with a lathe and be able to perform the numerous lathe operations.

11.0 Be able to set up and use a milling machine.

12.0 Be able to set up and use a surface grinder.

13.0 Has basic understanding of heat treatment.

14.0 Knows characteristics of ferrous and nonferrous metals.

TASK LISTING
VOCATION-MACHINE OPERATOR

DUTY	TASK
1. Knows the safety rules for safe operation of the shop and the machine tools.	Personal safety. Safe work practices. Safety with hand tools. Fire Prevention. First aid.
2. Knows how to read blueprints.	Knows how to interpret 3-view drawing. Knows how to use a working drawing. Knows different types of lines, dimensions and scales. Knows how to locate different dimensions from one view to the other. Know how to read and interpret sectional views. Know different hole representations: drilled reamed tapped bored Knows different thread representations. Knows how to interpret Auxillary views. Knows how to interpret symbols for: finish dimensioning types of materials Knows how to interpret specs & tolerances Knows how to interpret drawing for parts w/circular features.

3. Is proficient in shop math.

Knows how to add, subtract, multiply & divide whole numbers.
Knows how to add, subtract, multiply & divide fractions.
Knows how to add, subtract, multiply & divide decimals.
Has a basic working knowledge of the metric system in terms of length, mass, volume.
Has a working knowledge of different conversion units with respect to volume, area, length, etc., in the English systems.
Can convert English to metric & vice versa.
Has a basic intro to algebra in that the student can do the following:
- add, subtract, multiply & divide positive & negative numbers.
- Solve simple equations
- Solve word problems
- Ratio & proportions

Has a basic introduction to geometry & space relationships to include:
- Basic geometric figures
- Types of lines
- Angles - definitions & types
- Measurement of angles
- Solving for perimeter & area
- Circular measurement
- Pythagorean relationships
- Triangles

Has a basic introduction to trigonometry to include:
- Solving right triangle
- Trigonometric functions
- Trig formulas and tables

4. Knows how to use a variety of measurement, layout, inspection, and shop tools.	Knows principles of measurement. Knows how to use steel square. Knows how to use calipers. Knows how to use layout tools. Knows how to use ballpeen hammer. Knows how to use layout dye. Knows how to use scriber. Knows how to use dividers. Knows how to use prick and center punch. Knows how to use surface gauge. Knows how to use 6 and 12" rulers. Knows how to use combination sets. Knows how to use precision measuring tools: Micrometer Vernier caliper Dial indicators Depth micrometer Telescoping gauges Vernier height gauge Knows how to use set up tools: Vises Parallels Hold downs Angle plates
5. Knows how to identify and use various threading systems.	Screw thread terms. Identify difference between UF and UC threads. Knows how to select and use taps and tapping accessories for hand tapping. Knows how to select and use hand threading dies.
6. Knows how to properly set up and use a pedestal grinder.	Knows how to change wheels, adjust tool post, dress and true wheels, and put in operation.
7. Knows how to properly use stock cutoff tools.	Knows how to select proper blade. Knows how to set up and cut various shapes of stock. Knows how to use properly a hand hacksaw.

8. Knows how to properly use a hacksaw.	Safety Select and change proper blade. Perform cuts with the saw.
9. Use drills & perform drilling operation on drill presses & related drilling machines (Radial drill).	Safety. Knows parts of drill press. Knows now to sharpen drills. Calculate speeds and feeds. Knows how to properly lay out & drill a hole accurately. Know how to set up and ream a hole. Drill and tap in drill press.
10. Be proficient with a lathe.	Safe operation. Knows lathe parts. Be able to set up 3 & 4 jaw chucks. Be able to set up collet chuck. Be able to grind various lathe tool bits: RH LH Facing Threading Cut Off-necking Calculate speed and feeds. Conduct lathe turning operations. Set up and use steady rest and follower rest. Do drilling, boring, and reaming in lathe. Calculate and turn tapers. Set up & cut external threads. Set up & cut internal threads. Be able to maintain a lathe properly. Be able to set up & align centers.
11. Be able to set up and use vertical & horizontal milling machines	Know safety precautions involved with running milling machine. Know the various parts of milling machine. Be able to identify and use various milling cutters. Be able to calculate speeds and feeds. Be able to safely operate milling machine & complete milling project. Be able to set up and use dividing head.

12. Be able to set up & use a surface grinder.	Be familiar with safety requirements of operating grinder. Know different parts of grinder. Set up & use the surface grinder.
13. Have basic understanding of heat treatment.	Be familiar with terminology. Use heating ovens. Use different quenching media. Use Rockwell tester.

PERFORMANCE OBJECTIVES

DUTY AND TASK STATEMENTS	PERFORMANCE OBJECTIVES
Duty Statement	Terminal Objective
1. Knows the safety rules for safe operation of the shop and the machine tools.	Each student will, after being given proper instruction and demonstration, be able to recognize unsafe situations in the shop and be able to correct these unsafe conditions.
Task statements	Interim Objectives
1.1 Knows and practices personal safety.	After proper instruction and demonstration, the student will be able to demonstrate good habits with respect to clothing and safety equipment worn and not worn by the individual student when working in the shop as per current shop safety regulations.
1.2 Knows and performs safe work practices.	After proper instruction and demonstration, the student will be able to demonstrate to the instructor those safety practices that apply to all the machine tools such as inspecting the machine for safe operation, safe starting and stopping procedures, safe material handling, and safe cleanup.
1.3 Knows safety with hand tools.	The student will, after proper instruction and demonstration, be able to demonstrate to the satisfaction of the instructor how to select, handle, and identify safe and unsafe hand tools such as chisels, punches, and wrenches.
1.4 Knows fire prevention.	The student will, after proper instruction and demonstration, know and be able to demonstrate proper storage of flammables, how to use fire extinguishers, and how to handle minor shop fires.
1.5 Knows first aid.	The student will, after proper instruction and demonstration, be able to handle minor first aid emergencies such as cuts and bruises and burns as they occur in the shop.

DUTY AND TASK STATEMENTS	PERFORMANCE OBJECTIVES
Duty Statement	Terminal Objective The student will be able to:
2.0 Knows how to read blueprints.	Interpret the drawing, lay out the work piece and be able to construct on machine the work piece according to the blueprint specifications, given a blueprint to work from. This must be done with 100% accuracy.
Task Statements	Interim Objectives The student will be able to:
2.1 Knows how to interpret 3-view drawing.	Read, understand and use the drawing to accurately machine the part or parts given a 3-view drawing. 100%
2.2 Knows how to use a working drawing.	Interpret the drawing, locate all dimensions, and interpret all specifications given a working drawing from the drafter.
2.3 Knows different types of lines, dimensions, & scales.	Distinguish the different types of lines: Object lines Hidden lines Center lines Dimension lines given a blueprint. Work with the different types of dimensions Fractional Decimal Metric given a blueprint. Distinguish between the different types of scales used w/ blueprints in relation to the size of the drawing vs the size of the actual part. All of the above will be at 100%.

DUTY & TASK STATEMENT	PERFORMANCE OBJECTIVE
	The student will be able to:
2.4 Knows how to locate different dimensions from one view to the other.	Effectively locate all the necessary dimensions to machine the part, given a blueprint. 100%
2.5 Knows how to read and interpret sectional views.	Read and interpret: Full sections Half sections given a blueprint with sectional views on it. 90%
2.6 Knows different hole representations.	Distinguish among the many different ways of representing a hole and the specifications that may be associated with the hole: Threaded hole Drilled hole Tapered hole Bored hole Reamed hole Countersunk Counterbored given a blueprint. 100%
2.7 Knows the different thread representations.	Interpret all the specifications associated with the thread represented. Size, length, class Internal External, etc. V, Square, Acme given a blueprint. 100%
2.8 Know how to interpret auxilliary views.	Interpret the auxilliary view to better understand the drawing given a blueprint. 90%

TASK STATEMENT	PERFORMANCE OBJECTIVE
	The student will be able to:
2.9 Knows how to interpret symbols or abbreviations.	Interpret all the symbols and/or abbreviations in order to properly understand the drawing and properly machine the part based on current industry standards. Also dependent on individual company & their own symbols/abbreviations, given a blueprint. 90%
2.10 Knows how to interpret specifications & tolerances.	Properly interpret the drawing and note any particular specifications or tolerances as determined by the drafter, given a blueprint. 100%
2.11 Knows how to interpret circular part drawing and combined flat & circular parts.	Properly interpret the drawing with circular parts and note those pecularities associated with interpreting these types of drawings, given a blueprint. 90%

NOTE:
It is assumed that these objectives will be accomplished through lecture and demonstration. In all cases, these tasks will also be accomplished through practical application to the machining projects that will be done throughout the course.

DUTY AND TASK STATEMENT	PERFORMANCE OBJECTIVE
DUTY STATEMENT	TERMINAL OBJECTIVE
	The student will be able to:
3.0 Knows basic shop math.	Demonstrate a working knowledge of mathematical procedures that will allow him/her to do the proper computation to solve the problems. The student will be familiar with basic math, algebra, geometry, and trigonometry, given a set of math problems common to machine shop.
Task Statement	Interim Objective
	The student will be able to:
3.1 Knows how to add, 3.2 subtract, multiply, 3.3 and divide whole numbers, 3.4 fractions, decimals.	Solve problems involving addition, subtraction, multiplication, and division of whole numbers, fractions, & decimals as they relate to machine work. 100%
3.5 Has a basic working knowledge of the metric system in terms of length, mass, and volume.	Work with the different units of metric measure as they apply to the machine shop. 80%
3.6 Has a working knowledge of the English system of conversion units in term of length, area, volume.	Work with the different units of English measure as they apply to the machine shop. 100%
3.7 Knows how to convert English to metric and vice versa.	Convert English measurement of length, area, mass to metric measurement and metric measure to English measure, given a set of problems. These problems would relate to machine shop work. 90%

DUTY STATEMENT	PERFORMANCE OBJECTIVES
	The student will be able to:
3.8 Has a basic introduction to algebra in that the student is able to perform the following: Add, subtract, multiply & divide positive & negative numbers Solve simple equations Solve word problems Ratio and proportion.	Add, subtract, multiply, & divide positive & negative numbers. Set up and solve simple equations, solve word problems and do ratio and proportion problems, after proper instruction and practical exercise. This algebra will relate to every day problems as encountered in the machine shop. 80%
3.9 Has a basic introduction to geometry & space relationships to include: Basic geometric figures Types of lines Angles-definitions-types Measurement of angles Circular measurement Pythagorean relationships Triangles.	Work with geometry and space relationships as they relate to the machine shop. The student will know the different geometric figures, definition, and measurement of angles, circular measurement and its relationship to geometry. Also the student will know Pythagorean relationships and triangles after lecture and practical exercise. It is recognized that time permitting this can only be a basic introduction. 80%
3.10 Has basic introduction to trigonometry to include: Solving right triangles Trigonometric functions Trigonometric tables and formulas.	Work with the basic fundamentals of trigonometry to include solving right triangles, working some of the more common trigonometric functions and be able to use some formulas and work with the trig tables, after proper instruction and practical exercise. It is recognized that time permitting, this will be done on a very limited basis. 80%

DUTY AND TASK STATEMENT	PERFORMANCE OBJECTIVE
DUTY STATEMENT	TERMINAL OBJECTIVE
4.0 Knows how to use a variety of measurement, layout, inspection & set up tools.	Given the tools available in the shop, the student will be able to properly use and care for them.
TASK STATEMENT	INTERIM OBJECTIVE
4.1 Knows the principles of measurement.	After proper instruction and demonstration, the student will be able to demonstrate a working knowledge of the English system of linear (straight) measurement. 100%
4.2 Knows how to use layout tools such as: Steel square Dividers Ball peen hammer Layout dye Scriber Prick and center punch Surface gage 6" and 12" rulers combination sets.	Given a piece of flat stock, and a blueprint, the student will be able to transfer the blueprint information to the flat stock using these layout tools available in the machine shop. Accuracy +1/64"
4.3 Knows how to use precision measuring tools such as: Micrometer Vernier caliper Dial indicators Depth micrometers Telescoping gages Vernier height gage.	a. After proper instruction and practice, the student will be able to demonstrate to the instructor that he/she can properly use the micrometer. 100% b. After proper instruction and practice, the student will demonstrate to the instructor that he/she can properly use a vernier caliper. 100% c. After proper instruction and practice, the student will demonstrate to the instructor that he/she can properly use a dial indicator. 100%

DUTY STATEMENT	PERFORMANCE OBJECTIVE
4.3 (continued)	d. After proper instruction and practice, the student will demonstrate to the instructor that he/she can properly use a depth micrometer. 100%
	e. After proper instruction and practice, the student will demonstrate to the instructor that he/she can properly use a set of telescoping gages. 100%
	f. After proper instruction and practice, the student will demonstrate to the instructor that he/she can properly use a vernier height gage. 100%
4.4 Knows how to use set up tools such as: a. Vises b. Parallels & angle plates c. Hold-downs & V blocks	a. After proper instruction, the student will be able to demonstrate to the instructor the proper use of a vise. 80%
	b. After proper instruction and practice the student will demonstrate to the instructor the proper use of parallels & angle plates in a combined set up. 80%
	c. After proper instruction and practice the student will demonstrate to the instructor the proper use of hold downs and V blocks. 80%

DUTY AND TASK STATEMENTS	PERFORMANCE OBJECTIVES
Duty Statement 5.0 Knows how to identify and use various threading systems.	Terminal Objective Given a set of taps and dies the student will be able to identify, select, and use the proper tap or die for a given operation.
Task statements 5.1 Knows screw thread terminology.	Interim Objectives After proper instruction and demonstration the student will be familiar with and tested on the various terms used in conjunction with screw threads. 80%
5.2 Knows the various screw threads available for use on machine operations.	After proper instruction, demonstration, and practice, the student will be able to identify national fine, national course, and Acme. 100%
5.3 Knows how to select and use taps and tapping accessories for hand tapping.	Given a set of taps and several threaded hole sizes the student will be able to select the proper tap for the hole size and thread the hole. 100%
5.4 Knows how to select and use hand threading dies.	Given a set of threading dies & several external thread specifications the student will be able to select and use the proper size die to thread a piece of stock. 100%

DUTY AND TASK STATEMENT	PERFORMANCE ORJECTIVE
DUTY STATEMENT 6.0 Knows how to properly set up & use a pedestal grinder.	TERMINAL OBJECTIVE Given a pedestal grinder with two new wheels, the student will change the wheels, adjust the tool rests, dress and true the wheels and put back into operation. Done to the satisfaction of the instructor.
DUTY STATEMENT 7.0 Knows how to properly use the stock cut-off saw.	TERMINAL OBJECTIVE Given the power cut-off saw in the shop, the student will be able to select the proper blades, put into operation, and cut a piece of stock to a specified length. Done to the satisfaction of the instructor.
TASK STATEMENT 7.1 Knows how to select proper blade for the work to be done.	INTERIM OBJECTIVE Given several different pieces of stock, the student will select the proper blade to cut the stock. 80%
7.2 Know how to set up to cut various shapes of stock.	Given several different shapes of stock, the student will select the proper blade if necessary, set the stock in the saw and cut to the required length. 80%
7.3 Knows how to properly use a hand hack saw.	After proper instruction and demonstration the student will demonstrate to the instructor that he/she can properly and safely set up and use a hand hack saw. 100%

DUTY AND TASK STATEMENT	PERFORMANCE OBJECTIVE
DUTY STATEMENT 8.0 Knows how to properly use a band saw.	TERMINAL OBJECTIVE Each student will, when given a piece of stock, know how to safely and properly use the band saw to complete his/her work on the saw. All will be done to the satisfaction of the instructor.
TASK STATEMENT 8.1 Knows the safety procedures for operating the band saw.	INTERIM OBJECTIVE The student will, after proper instruction and demonstration, be able to safely operate the band saw. 80%
8.2 Select and change blades.	The student will, after proper instruction and demonstration, demonstrate to the instructor that he/she can select the proper blade, according to the metal being cut, change the blade and put the saw back into operation. All will be done to the satisfaction of the instructor.
8.3 Perform cutting operations with the saw.	The student will, after proper instruction and practice, be able to demonstrate to the instructor how to cut flat and round stock on the band saw. All will be done to the satisfaction of the instructor.

DUTY AND TASK STATEMENT DUTY STATEMENT	PERFORMANCE OBJECTIVE TERMINAL OBJECTIVE
9.0 Use drills & perform drilling operations on a drill press & related drilling equipment.	Each student will, after proper instruction, demonstration and practice, have a basic knowledge of drilling operations such as setting up the drill press, selecting the proper drills, performing tapping and reaming operations. All this will be done in accordance with accepted industry practices and to the satisfaction of the instructor.
TASK STATEMENT	INTERIM OBJECTIVE
9.1 Safety.	Each student will, after proper instruction and demonstration, know how to set up and operate the drill press safely. All will be done to the satisfaction of the instructor.
9.2 Knows the parts of a drill press.	Each student will, after proper instruction and demonstration, be able to demonstrate to the instructor, a working knowledge of the various parts of a drill press. 80%
9.3 Knows how to sharpen drills.	Each student will, after proper instruction and demonstration, be able to set up and properly sharpen a number of drills on the drill grinder. 100%
9.4 Calculate drill speeds.	Each student will be able to demonstrate to the instructor that he/she can calculate the proper drilling speed for a number of drill sizes. 80%
9.5 Set up and drill holes.	Given a number of hole size requirements, each student will be able to set up and properly drill the holes. 100%
9.6 Set up, drill & ream a hole.	Given a number of reamed hole specifications, each student will be able to set up, select the proper drill, drill and ream the holes. All will be done to the satisfaction of the instructor.
9.7 Knows how to tap with a drill press.	Given a number of threaded hole requirements, each student will be able to set up, select the proper tap drill, drill and tap the required number of holes. 100%

DUTY AND TASK STATEMENT	PERFORMANCE OBJECTIVE
DUTY STATEMENT	TERMINAL OBJECTIVE
10.0 Be proficient with a lathe.	Each student will, after proper instruction, demonstration and practice, be able to demonstrate to the instructor's satisfaction the large number of operations that can be performed on a lathe such as turning, tapering, threading, boring, reaming and cut-off. All will be done according to accepted industry practices. All will be accomplished by successful completion of a specified lathe project.
TASK STATEMENT	INTERIM OBJECTIVE
10.1 Safe operation.	The student will, after proper instruction, be able to set up the lathe in a safe manner. This will be done according to the safety rules in the shop and to the satisfaction of the instructor.
10.2 Knows the parts of a lathe.	The student will, after proper instruction and demonstration, be able to identify the various parts of the lathe. All will be done to the satisfaction of the instructor.
10.3 Be able to grind lathe tool bits: Right hand tool Left hand tool Facing hand tool Threading hand tool Cut-off hand tool.	The student will, after instruction and practice, be able to properly grind the designated lathe tool bits, taking into consideration the proper cutting angles and the lathe operation to be done. This will all be done according to industry specifications and to the satisfaction of the instructor.
10.4 Calculate speeds & feeds.	The student will, after proper instruction and practical exercise, be able to calculate the proper turning speeds and feeds for a variety of metals found in the shop. All will be done according to the manufacturer's specifications and accepted industry standards. 80%

DUTY STATEMENT	PERFORMANCE OBJECTIVES
10.5 Do lathe turning operations.	The student will, after proper instruction, demonstration and practice, be able to perform a number of lathe turning operations according to a blueprint as specified by the instructor. All dimensions will be as specified on the print.
10.6 Set up and use steady rest and follower rest.	Given a specific situation, the student will be able to properly set up and use the steady rest & the follower rest to do a lathe turning operation. This will be done to the satisfaction of the instructor.
10.7 Do drilling, reaming and boring operations on the lathe.	Given the requirement, the student will, after proper instruction and demonstration, be able to set up the lathe and perform a drilling operation, a boring operation and a reaming operation. All will be done to the satisfaction of the instructor.
10.8 Calculate & turn tapers.	The student will, after proper instruction and practice, be able to calculate, set up and turn a taper to specified dimensions. This will be done to the satisfaction of the instructor.
10.9 Set up & cut external threads.	The student will, after proper instruction and practice, be able to set up the lathe and cut an external thread. This will be done according to industry standards and to the satisfaction of the instructor.
10.10 Set up & cut internal threads.	The student will, after proper instruction and practice, be able to set up the lathe and cut an internal thread. This will be done according to industry standards and to the satisfaction of the instructor.

DUTY STATEMENT	PERFORMANCE OBJECTIVES
10.11 Be able to maintain the lathe properly.	The student will, after proper instruction and demonstration, be able to perform the required maintenance on the lathe according to manufacturer's specifications and to the satisfaction of the instructor.
10.12 Set up and align centers.	Given the requirement, the student will be able to use a dial test indicator and align the lathe centers according to manufacturer's specifications. ±.001 per 12 inches.

DUTY AND TASK STATEMENTS	PERFORMANCE OBJECTIVES
Duty Statement	Terminal Objective
11.0 Be able to set up & use milling machine.	After proper instruction and demonstration, the student will be able to safely set up and use the milling machine.
Task statements	Interim objectives
11.1 Knows safety requirements/ precautions involved with running milling machine.	The student will after instruction, demonstration, and practice, be able to demonstrate to the instructor the safe operation of the milling machine. 80%
11.2 Knows the various parts of the milling machine.	The student will, after instruction and demonstration, be able to identify the major parts of the milling machine. 80%
11.3 Be able to identify and use various milling cutters.	The student will, after instruction and practice, be able to select and use the various cutters used on milling machines. 90%
11.4 Calculate speeds & feeds.	The student will be able to calculate the proper speeds and feeds for the various cutters. 90%
11.5 Complete milling machine project.	Given a blueprint for a milling machine project, the student will be able to properly and safely set up the milling machine and complete the project within the guidelines set by the print and to the instructor's satisfaction.
11.6 Set up and use a dividing head.	After instruction and demonstration, the student will be able to properly set up and use the dividing head and accessories to complete a project.

DUTY AND TASK STATEMENTS	PERFORMANCE OBJECTIVES
Duty Statement	Terminal Objective
12.0 Be able to set up & use a surface grinder.	After proper instruction and practice, the student will be able to set up and use safely a number of grinding machines to include the cylindrical & surface grinders.
Task Statements	Interim Objectives
12.1 Be familiar with safety requirements of operating the surface grinder.	After proper instruction and demonstration, the student will be able to demonstrate to the instructor the proper and safe operating procedures for the grinders.
12.2 Knows different parts of the grinder.	After proper instruction and demonstration, the student will be able to identify the major parts of the grinders in the shop. 75%
12.3 Set up and use the surface grinder.	The student will set up and complete a project within specified tolerances.

DUTY AND TASK	PERFORMANCE OBJECTIVES
Duty Statement	Terminal Objective
13.0 Have a basic understanding of heat treatment.	Upon completion of this block of instruction, demonstration, and practice, the student will have a good basic understanding of the principles, purposes, and uses of heat-treating as it applies to the machine tool trade.
Task Statement	Interim Objective
13.1 Knows terminology.	After a period of instruction, the student will demonstrate a basic understanding of the terminology associated with heat treating processes such as: 1. Hardening 2. Tempering 3. Quenching 4. Case hardening 5. Cyaniding 6. Nitriding 80%
13.2 Use heat-treating ovens.	Given the requirement to harden and temper a piece of steel, the student will demonstrate a knowledge of the proper temperatures and times to harden and temper a piece of steel to obtain the desired degree of hardness. Student will complete the hardening requirement with the electric oven to the satisfaction of the instructor.
13.3 Use different quenching media.	Given the requirement, the student will, after instruction and demonstration, set up three different quenching media and with several different types of stock, heat the stock in the oven and quench in the various media, observing the reaction of the metal to each quenching media.
13.4 Use the Rockwell Tester.	Given the requirement to test several pieces of metal for hardness, the student will use the Rockwell tester to satisfaction of the instructor.

DUTY AND TASK STATEMENTS	PERFORMANCE OBJECTIVES
Duty Statement	Terminal Objective
14.0 Knows characteristics of ferrous and non-ferrous metals.	After proper instruction, the student will be able to demonstrate to the instructor, a working knowledge of the various steel classification systems and non-ferrous classifications. 80%

KNOWLEDGE PROFILE

STUDENT _____ PROGRAM _____
DATE _____

BASIC MATH
can work with:

1. ___ Fractions
2. ___ Decimals
3. ___ Metric system
4. ___ 6" shop mile
5. ___ Basic geometric figures
6. ___ Angles
7. ___ Basic algebraic expression
8. ___ Right angle triangle
9. ___ Trigonometric formulas and tables

BLUEPRINT READING
can work with:

1. ___ The 3-view drawing
2. ___ A working drawing
3. ___ Dimensions & scales
4. ___ Sectional views
5. ___ Interpreting industrial drawing
6. ___ Threads
7. ___ Auxilliary views
8. ___ limits, tolerances & symbols

PRECISION MEASURING TOOLS
can work with:

1. ___ 6" rule
2. ___ Micrometers
3. ___ Vernier
4. ___ Gage blocks
5. ___ Limit gages
6. ___ Dial indicators
7. ___ Screw thread measurements
8. ___ Optical comparators
9. ___ Layout tools & procedures
10. ___ Hand tools and benchwork

LATHE OPERATIONS.
can work with:

1. ___ Engine lathe
2. ___ Turret lathe
3. ___ Carbide tooling
4. ___ H.S.S. tooling
5. ___ Turning
6. ___ Tapers
7. ___ Reaming
8. ___ Tapping
9. ___ threading
10. ___ 3 & 4 jaw chucks
11. ___ Work between centers
12. ___ Feeds & speeds

MILLING OPERATIONS
can work with:

1. ___ Horizontal milling machine
2. ___ Vertical millling machine
3. ___ feeds & speeds
4. ___ face milling
5. ___ End milling
6. ___ Straddle milling
7. ___ Hartford spacer
8. ___ Indexing or dividing head

GRINDING
can work with:

1. ___ Offhand tool grinding
2. ___ Horizontal surface grinders
3. ___ Surface finish
4. ___ Grinding wheel care
5. ___ Tool post grinder

Knowledge Profile (continued)

DRILLING OPERATIONS
can work with:

1. ___ Radial arm drill
2. ___ Drill press
3. ___ Feeds & speeds
4. ___ Drill point characteristics
5. ___ Cutting fluids

6. ___ Drilling
7. ___ Countersinking
8. ___ Spotfacing
9. ___ Reaming
10. ___ Tapping

CUT OFF MACHINES
can work with:

1. ___ Vertical bandsaw
2. ___ Horizontal bandsaw
3. ___ Bandsaw blade welder
4. ___ Feeds & speeds
5. ___ Abrasive cutoff machine

Signature _____ Position _____

KEY

1. Exposure to
2. Can perform with supervision
3. Can perform with limited supervision
4. Displays expertise

ATTITUDE PROFILE

STUDENT _____ PROGRAM _____

DATE _____

ACCURACY OF WORK
1. ___ Makes many errors
2. ___ Is Careless
3. ___ Usually accurate
4. ___ Is careful
5. ___ Consistently accurate

CARE OF WORKING AREA
1. ___ Very untidy
2. ___ Careless
3. ___ Keeps area clean
4. ___ Keeps area clean & orderly
5. ___ Exceptionally clean & orderly

USE OF MATERIAL/EQUIPMENT
1. ___ Rough
2. ___ Careless
3. ___ Adequate
4. ___ Careful
5. ___ Very careful

SPEED IN PERFORMING DUTIES
1. ___ Very slow
2. ___ Slow
3. ___ Adequate
4. ___ Fast
5. ___ Very fast

USE OF WORKING TIME
1. ___ Very wasteful
2. ___ Wastes time
3. ___ Fair use of time
4. ___ Keeps busy
5. ___ Busy and effective

JOB LEARNING AND APPLICATION
1. ___ Little or no learning
2. ___ Learns with difficulty
3. ___ Adequate
4. ___ Learns with ease
5. ___ Exceptional ability

RESPONSIBILITY
1. ___ Irresponsible
2. ___ Evades responsibility
3. ___ Accepts responsibility
4. ___ Seeks responsibility
5. ___ Seeks and handles well

INITIATIVE
1. ___ Does not exhibit any
2. ___ Very little
3. ___ Average
4. ___ Needs little direction
5. ___ Self-motivated

ATTENDANCE
1. ___ Frequently absent of late
2. ___ Absent or late often
3. ___ Absent or late ooccasionally
4. ___ Seldom late or absent
5. ___ Never absent or late

ATTITUDE TOWARD CO-WORKERS
1. ___ Does not get along
2. ___ Poor interaction
3. ___ Gets along satisfactorily
4. ___ Works well with others
5. ___ Excellent relationship

ATTITUDE TOWARD SUPERIORS
1. ___ Disrespectful
2. ___ Poor cooperation
3. ___ Cooperates when asked
4. ___ Cooperates willingly
5. ___ Very respectful and helpful

PERSONAL APPEARANCE
1. ___ Slovenly
2. ___ Untidy
3. ___ Tidy
4. ___ Neat, in good taste
5. ___ Exceptionally pleasing

SIGNATURE: _____ POSITION _____

MACHINE OPERATOR TRAINING PROGRAM

STUDENT PROFILE

STUDENT NAME_____ DATE_____

1. ATTENDANCE

a. Days absent Excused___ b. Days absent Unexcused___ c. Days tardy Excused___ d. Days tardy Unexcused___

2. FINAL EXAM GRADE_____

3. SHOP WORK

a. Required work completed

1. All_____ 2. Most_____ 3.Except for_____

_____

b. Production Jobs: (Comment)_____

_____

_____

4. Class standing of_____number of students.

Top 1/3_____

Middle 1/3_____

Bottom 1/3_____

MACHINE OPERATOR TRAINING PROGRAM

Laboratory Safety Procedures

The main causes of accidents in a machine tool laboratory can be attributed to poor housekeeping, loose clothing and hair, improper tool use, inaccurate setups, careless handling of sharp tools, flying chips, and the handling of metal chips.

1. Safety glasses will be worn at all times while in the machine tool laboratory.

2. Never wear loose clothing around machines. Remove sweaters, coats and ties.

3. No sandals, sneakers or shorts will be allowed in the laboratory.

4. Do not wear rings, watches, etc. which could be caught in the machinery.

5. Loose or long hair must be either tied back, tucked under a hat, or in a hair net.

6. No machine in the lab will be operated until the student has been briefed by the instructor in its proper use and operating procedures.

7. Always stop the machine before measuring, cleaning, oiling or making any adjustments.

8. Do not attempt to stop a machine with your hands.

9. Do not use rags near moving parts or running machines.

10. Never have more than one person operating a machine at one time.

11. Care must be taken in handling or working around cutters and cutting tools - they must be treated with respect.

Laboratory Safety Procedures (Continued)

12. All burrs should be removed from work pieces after all operations are complete and before parts are passed in.

13. Chuck wrenches must never be left in the lathe chuck.

14. Parts being drilled must never be held by hand. Always use a vise.

15. Cutting tools must always be removed before the machine is cleaned.

16. Care must be taken when passing by or between operators so as not to bump them. Absolutely no horseplay will be allowed in the laboratory.

17. Coolant must be applied to all milling cutters on the side coming off the work.

General Operating Procedures

1. All machines will be throughly oiled before operation.

2. Stock and supplies will be issued only by the instructor. This is EXTREMELY IMPORTANT to avoid losses to other classes.

3. No unassigned projects will be done unless permission is granted by the instructor.

4. Broken tools and equipment will be immediately reported to the instructor.

5. The student should report to the instructor upon completion of a job or if there is a tie-up of machines so other jobs or assignments can be made.

6. The tool crib and inspection area will be operated under an open door policy up to a time it might become necessary to issue tools and inspection equipment.

7. There will be no smoking in the machine tool laboratory.

Closing the Laboratory

Thoroughness, speed, cooperation and a minimum amount of noise is required to avoid confusion at the end of a laboratory session. The instructor, and only the instructor, will give the signal to clean up. No student will start to clean up ahead of time. The following procedure will be used:

1. Return all tools to the tool cabinet and inspection area.

2. Clean ALL MACHINES which you have used during the laboratory session.

3. Perform your assigned laboratory detail.

4. Wash up only AFTER all other clean up is done.

Class will not be dismissed until all lost tools are found, the laboratory is clean, and all individuals have completed their assigned detail.

KEEPING THE LABORATORY CLEAN IS UP TO ALL OF US.

A completed set of institutionally developed laboratory projects are available for each unit of instruction. Copies are available upon request.

Bibliography

Required Textbooks

Repp, Victor E. and McCarthy, William J., Machine Tool Technology, McKnight Publishing Co., 1979.

Carman, Robert A. and Carman, Marilyn J., Basic Mathematical Skills, John Wiley & Sons, Inc., 1981.

Brown, Walter C., Blueprint Reading for Industry, Goodheart-Wilcox Company, Inc., 1979.

Supplementary Materials

Schultz, Russel R., Blueprint Reading for the Machine Trades, Prentice-Hall, Inc., 1981.

Heineman, Stephen S. and Generro, George W., Machine Tools: Processes and Applications, Canfield Press, 1979.

Walker, John R., Machining Fundamentals, Goodheart-Wilcox Company, Inc., 1977.

Lascol, Orville D., Nelson, Clyde A. and Porter, Harold W., Machine Shop Operations and Set-ups, American Technical Society, 1973.